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ABSTRACT

Informal reports suggest that computer literacy (programming) is sought more often by boys than by girls and by students from middle SES backgrounds. In order to gather more systematic data on this perceived trend, questionnaires were sent to directors of summer camps and classes that offered training in programming for microcomputers. Twenty-three directors of summer programs, serving a total of 5,533 students, provided data on enrollment and socioeconomic characteristics of students, type of sponsorship of programs (private, public schools, universities). level of difficulty of programming classes, cost, and residential versus day use. Findings show that three times as many boys as girls were enrolled in the total sample. Furthermore, the ratio of males to females increased with grade, cost of program, and level of difficulty of course offerings. Ninety-eight percent of those enrolled were from middle class backgrounds, and 91 percent were Caucasian. While Asians were overrepresented, other minorities were underrepresented, possibly for economic reasons. Factors which may contribute to gender and SES/ethnic inequity in the access to computer literacy programs are discussed. (Author/CMG)

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GENDER AND SOCIOECONOMIC DIFFERENCES IN ENROLLMENT IN COMPUTER CAMPS AND CLASSES

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Abstract

Informal reports suggest that computer literacy (programming) is sought more often by boys than by girls and by students from middle SES backgrounds. In order to gather more systematic data on this point, questionnaires were sent to directors of summer camps and classes that offered training in programming for microcomputers. Twenty-three directors of summer programs, serving a total of 5,533 students, provided data on enrollment and social characteristics of students, type of sponsorship of programs (private, public schools, universities), level of difficulty of programming classes, cost, and residential versus day use. Three times as many boys as girls were enrolled in the total sample. The ratio of males to females increased with grade, cost of program, and level of difficulty of course offerings. Enrollment was 98 percent upper middle SES and 91 percent Caucasian. Asians were overrepresented; other minorities underrepresented, possibly for economic reasons. Factors which may contribute to gender and SES/ethnic bias are discussed.

GENDER AND SOCIOECONOMIC DIFFERENCES IN ENROLLMENT IN COMPUTER CAMPS AND CLASSES

The recent introduction of the microcomputer into the classroom and home may have created issues of equity with regard to both gender and socioeconomic background. Informal reports indicate that computer literacy (computer awareness and programming skills) is more likely to be acquired by boys than by girls, and by children from middle and upper middle class backgrounds (Boss, 1982; Crossette, 1982; "If women don't," 1982; Tinker, 1982). At this writing, however, we could find no data that document these impressions of sex and SES (socioeconomic status) differences in microcomputer use.

The disparities in computer literacy obviously have theoretical and social importance. The social significance follows from economic and educational opportunities open to students who have computer knowledge. These differences in the tendency to acquire programming skills may be expected to increase gender and socio-ethnic inequities that now exist in the labor market. The new technologies may threaten gains in educational and career opportunities for women and minorities that have been achieved at great effort in the past two decades.

The purpose of this study was to identify students who voluntarily seek to acquire computer knowledge and programming expertise. Although some schools offer computer-based instruction, including courses in

programming, the extent to which such courses are required or encouraged varies from district to district. Roughly twice as many high income schools (80%) as low income schools (40%) had acquired a microcomputer by mid-year 1982 (Market Data Retrieval, 1982). The presence of micros in a school, however, does not in itself indicate the extent or pattern of use. Experience with computers in the schools may not involve programming. Computers are used in the schools primarily for instruction in drill-and-practice courses or for instruction in computer literacy, which does not necessarily include courses in computer programming ("School uses of microcomputers," 1983).

Computer camps and summer classes teach programming, usually BASIC, and may include advanced classes in BASIC, PASCAL, and assembly languages. Thus, enrollment in summer camps and classes may offer a more representative dataset from which to identify the student who is actually gaining proficiency in computing skills. This is a report of sex and socioeconomic differences in enrollment in computer camps and summer classes offered throughout the United States in the summer of 1982, with analysis of gender differences by age, social background of students, and selected characteristics of classes and camps.

Method

Research group. The data were gathered by questionnaire with follow-up by phone from directors of computer camps and summer workshops and classes. Computer camps and workshops were identified from three

sources: listing in microcomputer journals and journals on educational computing, direct personal contacts with professionals in the field (e.g., curriculum consultants from county offices of education), and advertisements of classes and camps that appeared in the mass media. A total of 35 camps, workshops, and classes were identified. Directors were contacted by letter or by phone. Twenty-three directors (66%) responded to the initial request. Directors who did not respond within six weeks were called and the request for data was repeated by phone. In three instances, we were unable to contact the director -- the phone had been disconnected or the person answering the phone had no knowledge of the camp. In four cases, the data were incomplete or inappropriate or the procedures used to select students distorted the correspondence between the applicant pool and final enrollment figures. Five directors agreed to send data but did not do so. No one explicitly refused to participate. A total of twenty-three directors provided usable data. Some camps offered several sessions, each serving a different group of students during the summer. The total number of groups could not be identified precisely, but we estimated it to be 132. The data came from 5,533 students in approximately 132 different instructional groups, run by twenty-three different sponsors (Table 1).

Table 1 goes about here

The camps were located in various parts of the United States; about half were in the western states. Three directors were located in the eastern seaboard states. These three directors reported total enrollments of 1,784 -- 32% of the total. One of these directors reported for several camps which were located in the midwest and south as well as the eastern part of the country.

Instrument. A one-page questionnaire was prepared to gather data on enrollment. Items asked for enrollment by age, and/or grade, sex, SES of participants, and ethnic origin. Information was gathered as to whether the enrollment accurately reflected the pool of applicants to the camp. Most directors were confident of the accuracy of data on enrollment figures by sex and age of student. They were less well informed about the social background of individual students, but had firm impressions of the SES character of the group. All data reported here are based on information provided by the directors.

Categories for data analysis. Grade and/or age of student were divided into three broad grade levels: primary (grades K through 4), middle school (grades 5 through 8), and high school (grades 9 through 12). Sponsorship of the sessions was identified as 1) private/corporate, 2) public schools, and 3) universities. Course offerings were grouped into 1) beginning and intermediate programming, 2) advanced programming, and 3) assembly language. SES was assigned as -- low, middle, and upper. Ethnicity was categorized as Caucasian, Black, Hispanic, Asian, and Native American.

Analysis. The analysis of gender and socioeconomic enrollment was designed to answer questions about gender and SES differences for the total group. In addition, data were examined to determine whether the magnitude of gender differences varied by age of student, level of difficulty of programming courses, cost and residential character of the camp, and by type of sponsorship.

Some differences between proportions of males and females and SES groups were so large that statistical tests were unnecessary to establish significance of the results. Where it seemed appropriate, significance of differences and of interactions between gender and other characteristics (age, cost, etc.) was examined by the use of Chi-square test of significance.

Results

Gender Differences

Overall results. The ratio of boys to girls in computer camps and summer classes was rougly three to one in each of three sponsorship categories (Table 2). The overall proportion was 73.8% boys to 26.2% girls. Enrollment of boys exceeded that of girls in each of the 23

Table 2 goes about here

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reporting groups, although there was some variation across classes. The proportion of girls at any one site ranged from 5% to 43% and reflected

the applicant pool as well. These differences for the total group were highly significant. The hypothesis that the proportion of boys and girls in the population is equal, using the large sample approximation of the binomial test, is clearly untenable ($z = 35.34$, $p < .0001$). The proportion of boys in the group was .738. The 95% confidence interval for the proportion of boys in the population had an upper boundary of .749 and a lower boundary of .726.

Variation by grade level in gender differences. For the total group, sex differences were significantly related to age of student ($\chi^2(2) = 10.90$, $p < .005$). More girls were enrolled at early grade levels. The proportion of females was 30% in primary grades; 26% in the middle school grades; and 24% in high school. The trend of difference by age was significant ($p < .0001$) using a test for a linear trend in proportions (See Snedecor & Cochran, 1980, Sec. 11.9).

Variation by difficulty of computer curriculum. Differential enrollment was even more striking when tallied by level of course offering. Three programs (student N = 599) categorized courses by level of difficulty. The proportion of females enrolled in beginning and intermediate classes was 28%; the proportion taking advanced programming was 14%; only 5% of those enrolled in assembly language courses were female. This trend of difference

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Figure 1 goes about here

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by level of difficulty was statistically significant by the test for

linear trends in proportions (Snedecor & Cochran, 1980) at $p < .0001$ (Figure 1).

Gender differences by cost and accommodation. The proportion of boys was highest in high-cost residential camps. Since cost of camps and classes differed by type of accommodation (residential vs. day session only), the effect of cost of program on gender differences in enrollment was examined by comparing gender differences by cost separately for day classes and for camps which were residential. Gender disparities were associated with cost in both types of accommodations (gender by cost for day classes, $\chi^2(1) = 8.99$, $p < .003$; gender by cost for residential camps, $\chi^2(2) = 16.11$, $p < .0003$. The trend across incremental levels of cost was striking and, by the test for linear trends in proportions (Snedecor & Cochran, 1980), highly significant ($p < .0001$) (Figure 2).

Figure 2 goes about here

Variations across sponsor type. There were variations in gender disparities by type of sponsor. The proportion of girls was highest in camps or classes offered by the public schools and lowest in camps operated under private sponsorship ($\chi^2(2) = 66.56$, $p < .0001$). These comparisons were computed only for enrollment in the K-4 group ($\chi^2(2) = 40.78$, $p < .0001$) and middle school group ($\chi^2(2) = 22.55$, $p < .0001$). Of the groups included in this report, no classes were offered by public schools at the secondary school level (Table 1). Since type of sponsor

was associated with program cost, however, these differences in enrollment by type of sponsor may be attributable to cost rather than to identity of the sponsoring agency.

Differences in Enrollment by SES and Ethnic Origin

The questionnaire asked directors to estimate the economic level of students and their ethnic background. Not all of the camps responded to this question, and there was variation among directors in the confidence they expressed in their impressions of the SES and ethnic background of students. Those who did respond (65% of the total number of sites for SES and 70% for ethnicity) reported that students were predominantly middle and upper class (Table 3). This pattern is striking but not surprising. Enrollment in summer computer camps and

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Table 3 goes about here

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classes is also overwhelmingly Caucasian. Ninety-one percent of the students were described as Caucasian, Asians numbered 5%, Blacks 2.5%, Hispanics 1%, and Native Americans 0.5% (Table 3).

Discussion

We conclude from these results that training in computer programming outside of course offerings during the school year is sought more often

by males and by children and adolescents from middle and upper class families. Moreover, the disparity between girls and boys increases with age, is greater in advanced than in beginning classes, and is larger for expensive programs. Parents seem more willing to invest in this type of training for their sons than they are for daughters. This may reflect a perception by parents that such training is more likely to increase the future earning capabilities of boys than it is for girls -- as if the parents were engaging in a cost-benefit analysis in their decisions about sending children to computer camps.

These disparities cannot be accounted for by differences in enrollment of boys and girls in summer camps generally; according to the American Camping Association (ACA, personal communication, September 6, 1983), the ratio of boys to girls in their accredited coed residential camps is about even. It appears that the focus of computer camps on computing activities, rather than cost or camp setting, is the central factor in explaining the uneven distribution of boys and girls.

The differences reported in enrollment by SES and ethnic background are based on tentative data, but they correspond with data on distribution of micros among schools (Market Data Retrieval, 1982). The enrollment figures by ethnicity, however, do not reflect the distribution of the population at large. The United States Bureau of the Census figures for 1980 (U.S. Department of Commerce, 1981) lists the school enrollment figures as 82% Caucasian, 15% Black, and 8% Spanish Origin (persons of Spanish origin may be of any race). Separate school-age totals are

not given for other ethnic groups, but according to the population profile for the United States for the same period (U.S. Department of Commerce, 1981), Asians numbered 1.5% and Native Americans comprised 0.6% of the total population.

SES differences at this point in the development of small computers almost certainly reflect economic considerations. These camps are not inexpensive; tuition may range as high as $1,590.00 for a four-week session. The median reported by the camp directors was $490.00 for two weeks. Although 61% of the directors reported that scholarships were available, the proportion of the total enrollment receiving financial aid was not indicated. We suspect that this number was negligible since most camps are operated for profit or by institutions which would not be in a position to subsidize such activities.

Differences in ethnic background of students also indicate SES considerations. Since Blacks and Mexican-Americans are over-represented in low income sectors of the society, the low enrollment of these two minorities in computer camps can probably be accounted for in economic terms. Asians are over-represented; this may reflect their relatively higher economic level or their greater interest and ability in mathematics (Educational Testing Service, 1981).

The potential social consequences of these ethnic and SES differences have been described in dramatic terms by several writers. Students from low income areas may use computers in CAI lessons and these experiences

may offer an advantage over other methods of instruction (Kulik, Bangert, & Williams, in press). However, some observers fear that current trends in computer use will lead to a society in which high income students will instruct computers and low income students will be instructed by computers. This prediction also has implications for the gender differences reported here.

Gender differences in computer camp and summer class enrollment raise questions about the origin of the differential appeal that computer programming has for boys and girls. A number of explanations have been proposed in recent literature; others come easily to mind. We summarize them here briefly. Although some are more credible than others, given current knowledge of sex differences in other areas of behavior, they fall in a gray zone between hypotheses and speculations. These are the most plausible explanations.

Interest in computer programming follows traditional sex differences in mathematics. Sex-typing of school subjects may begin as early as the second grade (Stein & Smithells, 1969). Microcomputers in the schools are often assigned to mathematics and science classes (Lockhard, 1980); the faculty member who introduces micros to the school probably teaches either mathematics or science (Saunders, 1978). Where CAI classes are offered in the schools, the most visible and widely known programs involve drill-and practice arithmetic assignments. The association between mathematics and computer programming extends to manuals which are prepared for the new user of micros. One of the first examples of computer language in these manuals is likely to involve arithmetic. Math phobia transferred to the

computer is probably the most popular explanation for the results reported here (Winkle & Mathews, 1982).

The public stereotype of computers projects images of science, mathematics, engineering, and other male-dominated professions. Impressions of computers as controlled by males are promulgated by movies (e.g., 2001: A Space Odyssey, Star Wars) and by the public press and television. Males dominate scientific activities; computers are often shown as part of science in the mass media; and computers rarely appear in activities for which women have a significant degree of competence and experience. Word processing is the only notable exception.

Games and educational software designed for micros portray male-oriented themes. One motivational factor in learning to use a computer is its game-playing capabilities. Fifty-one percent of home computer owners reported they used their computers to play games (Time, 1983). Many computer games have militaristic titles ("Destroy All Subs," Submarine Attack," "Space Wars"); few express themes associated with female-oriented activities. Even the reputedly most popular computer game for women (Cobb, 1982; Skow, 1982) is called Pac-Man. Educational computer programs are most likely to be found in math and science courses, and some popular educational simulations (e.g., Oregon Trail, Hangman) are built around male themes of adventure and violence. When a random sampling of software titles was rated by 150 junior high school students, 35% of the titles were perceived as being primarily for boys, compared to only 5% that were judged to be of primary interest to girls (Miura & Hess, 1982).

Parents tend to encourage use of computers by boys rather than girls. According to one computer camp director, "Mothers bring their boys to the classes. Girls have to beg to be allowed to enroll." In our data, this preferential treatment appears to be related to cost. The male/female ratio in expensive camps is much greater than in inexpensive programs. Computers are most often to be found in homes of men whose work involves computers and related technologies. Fathers in these families provide information about computers, bring micros into the home and thus offer models of sex-typed use to their children. Both fathers and mothers apparently see computers and programming as having more continuity with the careers of sons than those of daughters. Encouraging boys to use computers thus has more economic utility for boys than for girls.

The symbolic and visual-spatial features of programming appeal more to boys than to girls. Sex differences in spatial abilities are well established in research literature (Aiken, 1972; Maccoby & Jacklin, 1974; McGuiness & Pribram, 1979; Van Leeuwen, 1978). Evidence is not yet available, but it seems possible that some of these skills apply to programming. These arguments invoke ancient controversies about sex differences in analytic and spatial reasoning abilities. These disputes will almost certainly find in computer programming and use another new arena for research and debate. In gathering data from camp directors, we often heard that girls are as proficient as boys in computer programming classes. Differences in ability to learn programming seem to us not to be a significant factor in the enrollment data reported here. This does not

rule out the possibility that some kind of computer-related differences exist; it does not explain the ratio of three-to-one in enrollment in these results.

We are unsure as to why the programs sponsored by the public schools had a higher percentage of girls than did other types of sponsors. This could be due to any number of factors including cost, personal encouragement from the regular classroom teachers, or a more varied offering of courses. Some of the public school sessions offered programming as only one part of a summer school curriculum. Girls may have been attracted by these other choices.

However, we are certain that computer literacy cannot be left to individual discretion if all segments of the population are to be prepared equally for the future in a technological workplace. The sex and socio-economic differences found in enrollment in computer camps and classes supports the general impression that computer knowledge and programming skills are not being acquired equitably.

We are still at an early stage in the development of computer literacy programs. The use of microcomputers in education started as a grass-roots movement and has followed traditional lines of affluence, education, and gender bias. Intervention by schools and other public agencies may be needed to prevent these inequities from becoming even more deeply ingrained into the society.

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Table 1

Characteristics of Participating Computer Summer Camps and Classes

Feature	Type of Sponsor			
	Private	Public School	University	Total
No. of camps	10	5	8	23
No. of students enrolled	2980	812	1741	5[illegible]3
Grade levels		(No. of students)		
Primary (K-4)	440	245	318	1003
Middle school (5-8)	1522	567	1128	3217
High school (9-12)	1018	-	295	1313
Cost		(No. of camps)		
No cost	0	0	0	0
Under $100	1	5	3	9
101 - 500	4	0	3	7
501 - 1000	4	0	2	6
1000+	1	0	0	1
Offer scholarships				
Yes	5	3	6	14
No	5	2	2	9
Region				
West	6	4	2	12
Midwest	2	1	3	6
South	1	0	1	2
East	1	0	2	3

Table 2

Enrollment in Computer Summer Camps by Sex, Grade Level, and Sponsorship

(Numbers and Percentages)

Sponsorship	Primary			Middle School			High School			TOTALS		
N	N	%F	%M	N	%F	%M	N	%F	%M	N	%F	%M
Private (N=10)	440	21	79	1522	22	78	1018	23	77	2980	22	78
Public School (N=5)	245	44	56	567	30	70	--	--	--	812	35	65
University (N=8)	318	31	69	1128	29	71	295	27	73	1741	29	71
TOTAL	1003	30	70	3217	26	74	1313	24	76	5533	26	74

Table 3

Distribution by Socioeconomic Background and Ethnicity of Students (Percentages)

SES (N = 3504)	
Middle and upper income	98%
Low income	2%

Ethnicity (N = 3607)		
Caucasian		91%
Minorities		9%
Asian	(5.0%)	
Black	(2.5%)	
Hispanic	(1.0%)	
Native American	(0.5%)	

Figure 1. Enrollment by difficulty of computer curriculum.

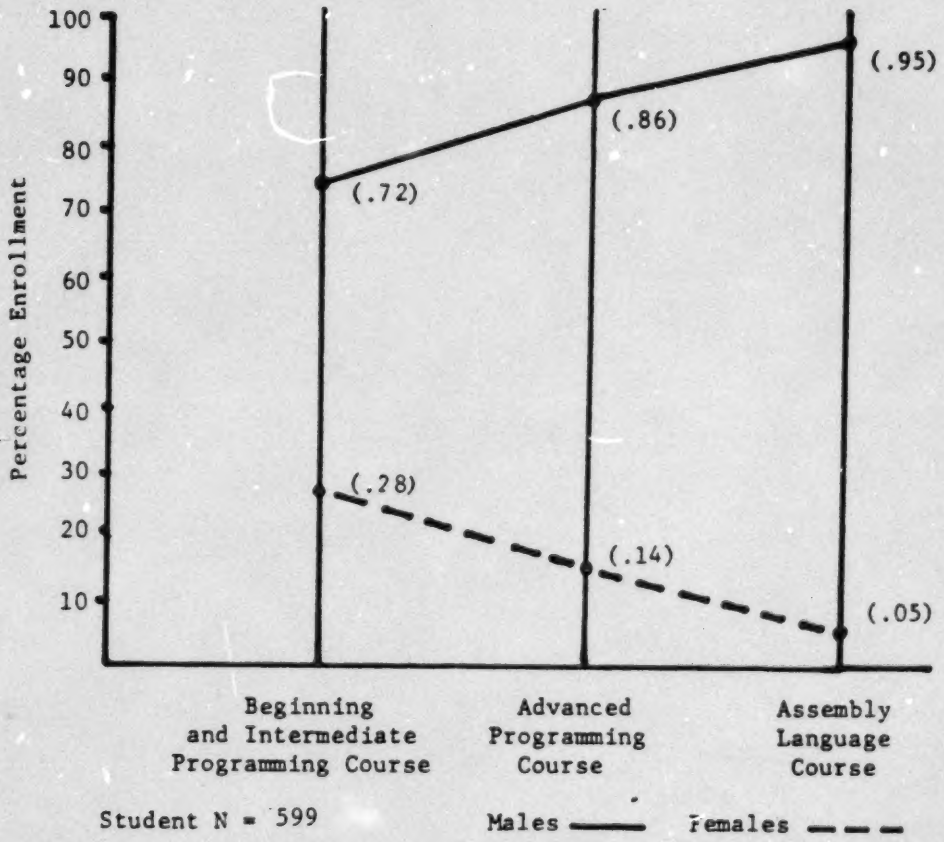

Figure 2. Enrollment by cost of sessions.